

Claims

1. A porous film for use in an electronic device, in particular a solar cell, said film having a front face and a back face, characterized in that said porous film has a gradient of light scattering strength extending from said front face to said back face, with the light scattering strength increasing towards said back face.
2. The porous film according to claim 1, characterized in that said gradient of light scattering strength starts with zero light scattering at said front face.
3. The porous film according to any of claims 1 – 2, characterized in that said porous film comprises at least two layers, each layer having a first kind of particles of one average diameter or length and one layer having additionally a second kind of particles having a larger average diameter or length.
4. The porous film according to claim 3, characterized in that said porous film comprises at least three layers, each layer having a first kind of particles of one average diameter or length, and at least one layer having additionally at least a second kind of particles having a larger average diameter or length.
5. The porous film according to claim 4, characterized in that said porous film comprises a plurality of layers, each layer having a first kind of particles of one average diameter or length, and at least one layer having additionally at least a second kind of particles having a larger average diameter or length.
6. The porous film according to any of claims 3 – 5, characterized in that said particles have a shape selected from the group comprising rods, tubes, cylinders, cubes, parallelipeds, spheres, balls and ellipsoids.

7. The porous film according to any of claims 3 – 6, characterized in that said particles are selected from the group comprising semi-conducting material particles, metal particles and insulating particles.
8. The porous film according to any of claims 3 – 7, characterized in that the at least two layers/three layers/plurality of layers have been applied subsequently.
9. The porous film according to claim 8, characterized in that the at least two/three/plurality of layers have been applied subsequently by a technique selected from the group comprising screen printing, doctor blading, drop casting, spin coating, sol gel process and lift-off techniques, and any combination of the aforementioned techniques.
10. The porous film according to any of claims 3 – 9, characterized in that the first kind of particles have an average diameter in the range of from 2 nm to 25 nm, preferably from 3 nm to 20 nm, or they have an average length of from 3 nm to 300 nm, preferably from 10 nm to 100 nm.
11. The porous film according to any of claims 3 – 10, characterized in that the second kind of particles have an average diameter or length in the range of from 50 nm to 1 μ m, preferably from 100 nm to 500 nm, more preferably from 200 nm to 400 nm.
12. The porous film according to any of claims 3 – 11, characterized in that, in the layer(s) having additionally a second kind of particles, the ratio of the first kind of particles to the second kind of particles is in the range of from 10:1 to 1:1, preferably from 8:1 to 2:1.
13. The porous film according to claim 12, characterized in that the ratio is a weight ratio.
14. The porous film according to claim 12, characterized in that the ratio is a volume ratio.
15. The porous film according to any of the foregoing claims, comprising a plurality of layers, each layer having a first kind of particles of one average diameter or length, and all but one layer having a second kind of particles, wherein in each of the layers having a second kind of particles,
either

- (i) the average diameter or length of the second kind of particles is the same in each layer and the amount of the second kind of particles present in each layer varies from layer to layer,

or

- (ii) the amount of the second kind of particles present in each layer is the same in each layer and the average diameter or length of the second kind of particles varies from layer to layer.

16. The porous film according to claim 15, characterized in that, where the amount of the second kind of particles present in each layer varies from layer to layer, it increases from layer to layer, and where the average diameter or length of the second kind of particles present in each layer varies from layer to layer, it increases from layer to layer.

17. The porous film according to any of claims 15 – 16, characterized in that the one layer having only a first kind of particles is closer to said front face of said porous film than to said back face.

18. The porous film according to claim 17, characterized in that said one layer having only a first kind of particle is adjacent to said front face.

19. Use of a porous film according to any of the foregoing claims in an electronic device, in particular a solar cell.

20. Electronic device comprising a porous film according to any of the claims 1 – 19.

21. Electronic device according to claim 20, which is a solar cell.

22. Solar cell according to claim 21, further comprising a reflective back electrode.

23. Solar cell according to any of claims 21 – 22, further comprising a light confinement layer.

24. Solar cell according to any of claims 21 – 23, further comprising an electrolyte.

25. A method of forming a porous film having a gradient of light scattering strength across its thickness, comprising the steps:

- a) providing a first kind of particles having one average diameter or length,
- b) providing a second kind of particles,
- c) providing a substrate,
- d) applying onto said substrate a plurality of layers, each layer having said first kind of particles of one average diameter or length, and all but one layer having said second kind of particles, wherein in each of said layers having a second kind of particles, either
 - (i) the average diameter or length of said second kind of particles is the same in each layer and the amount of said second kind of particles present in each layer varies from layer to layer,
 - or
 - (ii) the amount of said second kind of particles present in each layer is the same in each layer and the average diameter or length of said second kind of particles varies from layer to layer.

26. A method according to claim 25, characterized in that, where the amount of said second kind of particles present in each layer varies from layer to layer, said amount increases from layer to layer, and, where said average diameter or length of said second kind of particles present in each layer varies from layer to layer, said average diameter or length increases from layer to layer.

27. The method according to any of claims 25 – 26, characterized in that steps a), b) and c) can be in any order.

28. The method according to any of claims 25 – 27, characterized in that the application of said plurality of layers occurs by a technique selected from the group comprising screen printing, doctor blading, drop casting, spin coating, sol gel process, and lift-off techniques, and any combination of the aforementioned techniques.

29. The method according to any of claims 25 – 28, characterized in that each layer is applied separately.

30. The method according to claim 29, characterized in that after application of a layer there is a drying step.
31. The method according to any of claims 25 – 30, characterized in that the porous film is sintered after all layers have been applied.
32. A porous film produced by the method according to any of claims 25 – 31.
33. Use of a porous film according to claim 32 in an electronic device, in particular a solar cell.
34. An electronic device comprising a porous film according to claim 32.